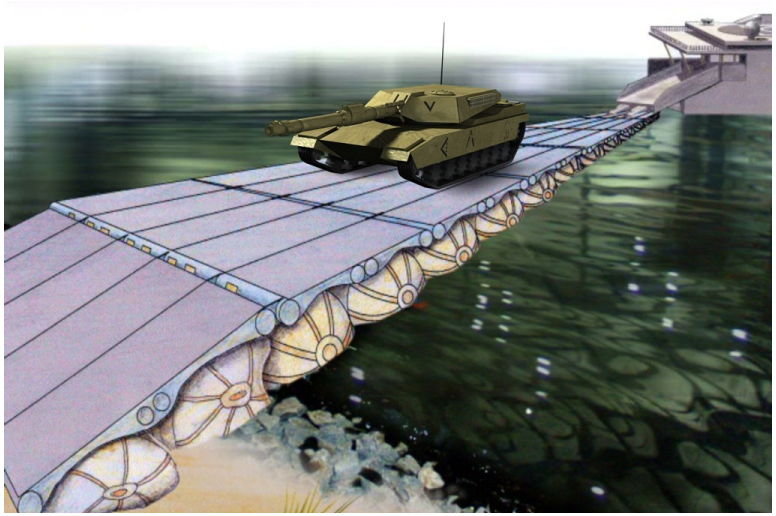
Sea-state and Static Testing of the 1:3 Scale Lightweight Modular Causeway System (LMCS)



Dr. Zeki Demirbilek and Mr. James Pratt
Coastal and Hydraulics Laboratory
US Army Engineer Research and Development Center

ERDC Engineer Research and Development Center

CHL Coastal and Hydraulics Laboratory

Outline

- Objectives
- Modeling considerations
- Test conditions
- Test results
- Conclusions
- Future tests

Objectives

- Validate conceptual design and analytical (FE) model
- Evaluate system performance
- Assess structural integrity of system under loading and wave conditions
- Evaluate suitability of flat cables/straps for system tensioning
- Determine freeboard vs. loading characteristics
- Assess buoyancy and freeboard requirements
- Use results/observations for future design improvements

Modeling Considerations

- Module scaling

Scaling parameter $\lambda = 3$

Parameter	Prototype	1:3 Model
Geometry, λ		
Hull - length x width x height	10 ft x 20 ft x 1.5 ft	3.33 ft x 6.67 ft x 0.5 ft
Floatation - diameter	5 ft	1.67 ft
Forces/Weight, λ^3		
Module weight	6,000 lbs	222 lbs
Flat cable	12 cables/module	8 cables/module
- Design working load	210,000 lbs/cable	11,575 lbs/cable
- Pre-tension	8,300 lbs/cable	460 lbs/cable
Stiffness (EI), λ^5		
Module	3.76E+10 lb-in^2	1.59E+8 lb-in^2

Modeling Considerations

- Static test loads

1:3 Model	Prototype
1,800 lbs	24 tons (Stryker)
4,100 lbs	55 tons (MLC50)

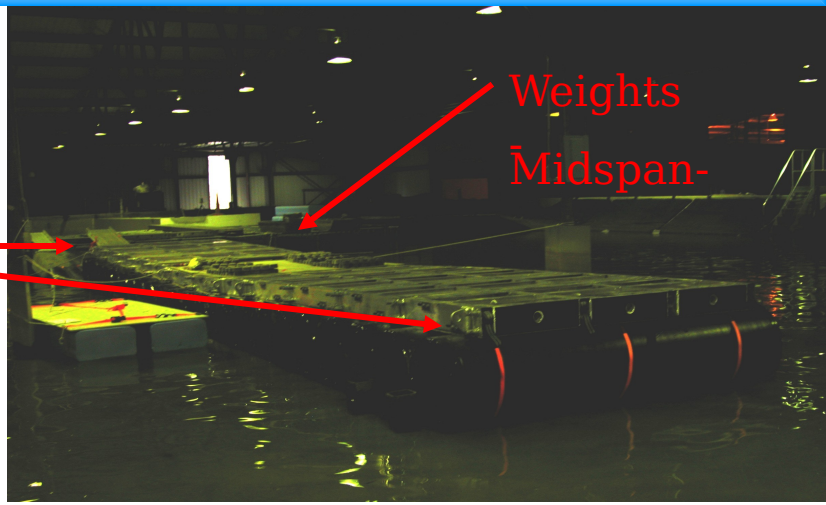
Note: Strap designed to have 20,000 lbs breaking strength. Pull test indicated breaking at 10,000 lbs.

- Discrepancy will be resolved later

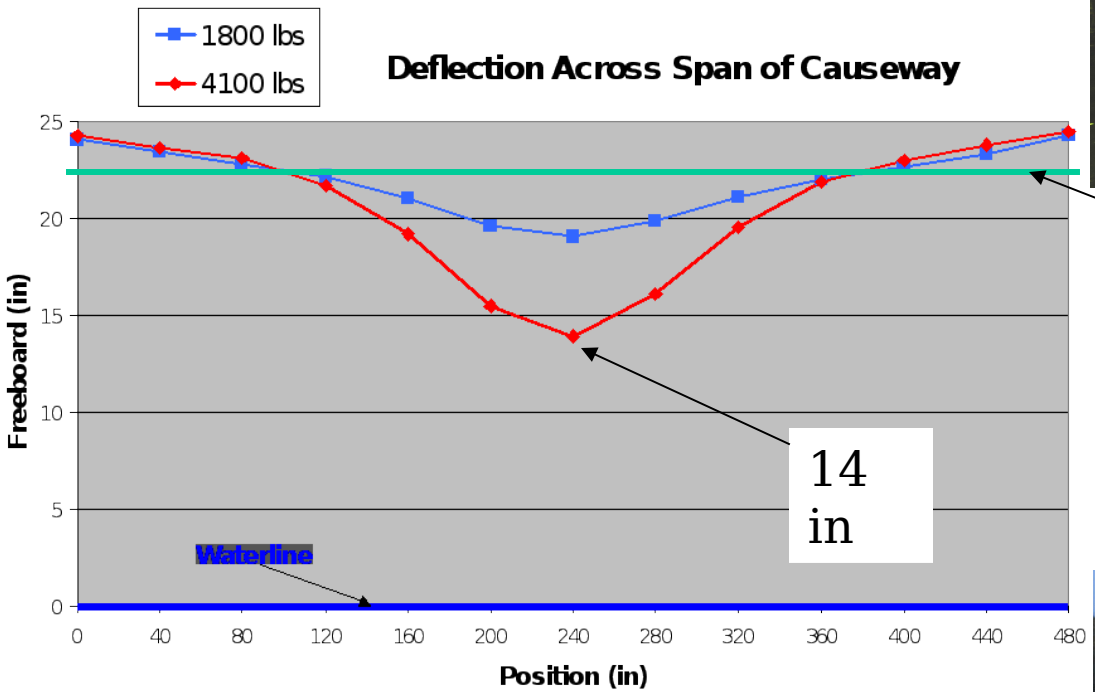
Test Conditions

- Static tests
  - Incremental loading over mid-span
    - Footprint representative of MIA2 tank
  - Deflection/freeboard measurements
- Wave tests
  - Wave conditions
    - SS2 – SS3
  - With and without payload

Test Conditions
- Static Tests-



Deflection range



23 in. initial freeboard

14 in

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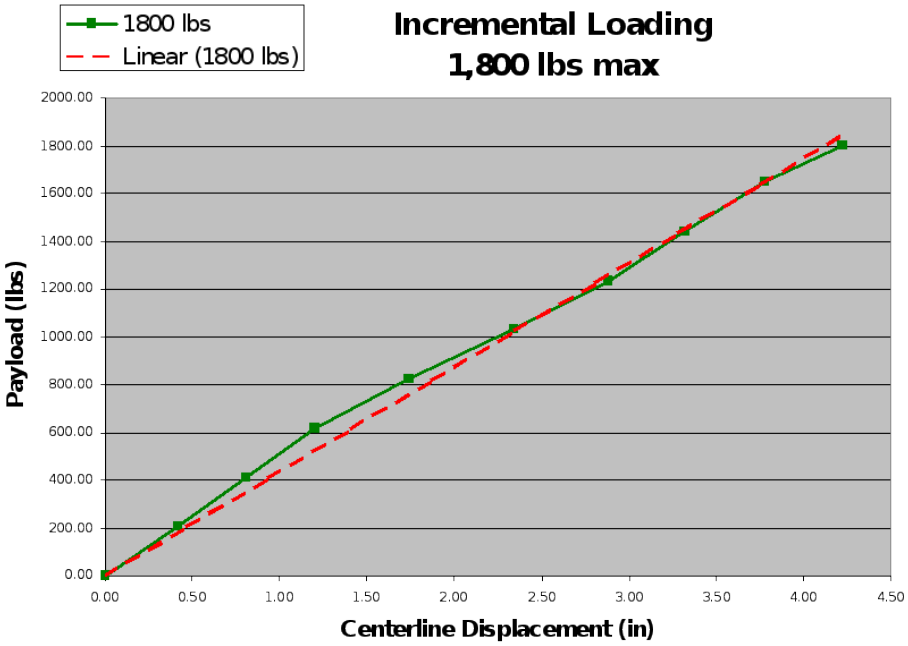
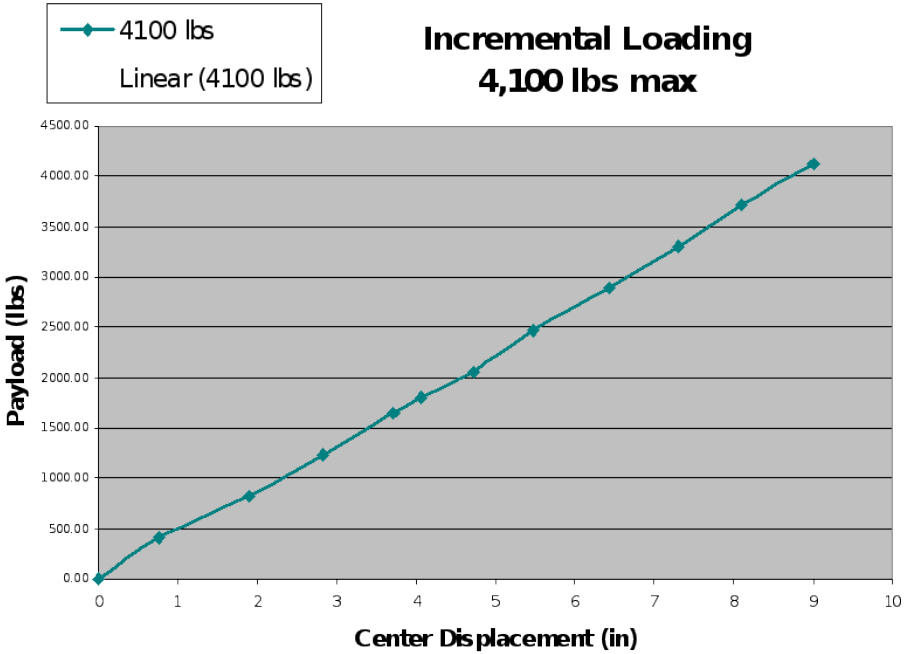
Test Conditions
- Static Tests-





200 lbs incremental loading

400 lbs incremental loading

- ❖ Loading at center of system for maximum displacement
- ❖ Centerline displacement as a function of payload is relatively linear

✓ **System behaves as a continuous structural beam**

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Test Results
-Wave Tests-

Wave Conditions

Wave direction	1:3 Waves		Prototype		
	Wave height (ft)	Period (s)	Wave height (ft)	Period (s)	**SS**
•180° • 135° • 90 °	0.5	1.5	1.5	2.6	**2**
	1		3		**3**
	0.5	3	1.5	5.2	**2**
	1		3		**3**
	0.5	4.5	1.5	7.8	**2**

Payload tested:

- No load
- 24 tons (only for 180°)

Test Results
-Wave Tests-

Prototype

- Wave height = 3 ft
- Wave period = 2.6 s
- SS3

Short wavelength

Test Results
-Wave Tests-

Prototype

- Wave height = 1.5 ft
- Wave period = 7.8 s
- SS3

Long wavelength

Conclusions

- System performance successfully tested up to 55 ton load
    - Predictions appear consistent with analytical solution
- System functioned well up to SS3 waves
- Straps remain intact under maximum static load (55 tons) and SS3 waves
- Retained 60% freeboard under maximum static loading

Future Tests

- Roll stability
- Test MLC70 (MIA2 tank)
- Wave conditions up to SS5 at varying angles
- Additional strap breaking tests
- Full-scale component testing

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